



DEPARTMENT OF THE AIR FORCE
59TH MEDICAL WING (AETC)
JOINT BASE SAN ANTONIO - LACKLAND TEXAS

14 FEB 2017

MEMORANDUM FOR 959 CSPA 44E1A

ATTN: CAPT BRIAN P. MURRAY

FROM: 59 MDW/SGVU

SUBJECT: Professional Presentation Approval

1. Your paper, entitled **Hydrofluoric Acid – The Burn that Keeps on Burning** presented at/published to **Academic Academy of Emergency Medicine Conference 2017, Orlando, FL, 16-20 March 2017** in accordance with MDWI 41-108, has been approved and assigned local file #**17068**.
2. Pertinent biographic information (name of author(s), title, etc.) has been entered into our computer file. Please advise us (by phone or mail) that your presentation was given. At that time, we will need the date (month, day and year) along with the location of your presentation. It is important to update this information so that we can provide quality support for you, your department, and the Medical Center commander. This information is used to document the scholarly activities of our professional staff and students, which is an essential component of Wilford Hall Ambulatory Surgical Center (WHASC) internship and residency programs.
3. Please know that if you are a Graduate Health Sciences Education student and your department has told you they cannot fund your publication, the 59th Clinical Research Division may pay for your basic journal publishing charges (to include costs for tables and black and white photos). We cannot pay for reprints. If you are 59 MDW staff member, we can forward your request for funds to the designated wing POC.
4. Congratulations, and thank you for your efforts and time. Your contributions are vital to the medical mission. We look forward to assisting you in your future publication/presentation efforts.

Linda Steel-Goodwin

LINDA STEEL-GOODWIN, Col, USAF, BSC
Director, Clinical Investigations & Research Support

PROCESSING OF PROFESSIONAL MEDICAL RESEARCH/TECHNICAL PUBLICATIONS/PRESENTATIONS

INSTRUCTIONS

USE ONLY THE MOST CURRENT 59 MDW FORM 3039 LOCATED ON AF E-PUBLISHING

1. The author must complete page two of this form:
 - a. In Section 2, add the funding source for your study [e.g., 59 MDW CRD Graduate Health Sciences Education (GHSE) (SG5 O&M); SG5 R&D; Tri-Service Nursing Research Program (TSNRP); Defense Medical Research & Development Program (DMRDP); NIH; Congressionally Directed Medical Research Program (CDMRP) ; Grants; etc.]
 - b. In Section 2, there may be funding available for journal costs, if your department is not paying for figures, tables or photographs for your publication. Please state "YES" or "NO" in Section 2 of the form, if you need publication funding support.
2. Print your name, rank/grade, sign and date the form in the author's signature block or use an electronic signature.
3. Attach a copy of the 59 MDW IRB or IACUC approval letter for the research related study. If this is a technical publication/presentation, state the type (e.g. case report, QA/QI study, program evaluation study, informational report/briefing, etc.) in the "Protocol Title" box.
4. Attach a copy of your abstract, paper, poster and other supporting documentation.
5. Save and forward, via email, the processing form and all supporting documentation to your unit commander, program director or immediate supervisor for review/approval.
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8. The 59 CRD/Publications and Presentations Section will route the request form to clinical investigations, 502 ISG/JAC (Ethics Review) and Public Affairs (59 MDW/PA) for review and then forward you a final letter of approval or disapproval.
9. Once your manuscript, poster or presentation has been approved for a one-time public release, you may proceed with your publication or presentation submission activities, as stated on this form. **Note:** For each new release of medical research or technical information as a publication/presentation, a new 59 MDW Form 3039 must be submitted for review and approval.
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11. The Joint Ethics Regulation (JER) DoD 5500.07-R, *Standards of Conduct*, provides standards of ethical conduct for all DoD personnel and their interactions with other non-DoD entities, organizations, societies, conferences, etc. Part of the Form 3039 review and approval process includes a legal ethics review to address any potential conflicts related to DoD personnel participating in non-DoD sponsored conferences, professional meetings, publication/presentation disclosures to domestic and foreign audiences, DoD personnel accepting non-DoD contributions, awards, honoraria, gifts, etc. The specific circumstances for your presentation will determine whether a legal review is necessary. **If you (as the author) or your supervisor check "NO" in block 17 of the Form 3039, your research or technical documents will not be forwarded to the 502 ISG/JAC legal office for an ethics review.** To assist you in making this decision about whether to request a legal review, the following examples are provided as a guideline:

For presentations before professional societies and like organizations, the 59 MDW Public Affairs Office (PAO) will provide the needed review to ensure proper disclaimers are included and the subject matter of the presentation does not create any cause for DoD concern.

If the sponsor of a conference or meeting is a DoD entity, an ethics review of your presentation is not required, since the DoD entity is responsible to obtain all approvals for the event.

If the sponsor of a conference or meeting is a non-DoD commercial entity or an entity seeking to do business with the government, then your presentation should have an ethics review.

If your travel is being paid for (in whole or in part) by a non-Federal entity (someone other than the government), a legal ethics review is needed. These requests for legal review should come through the 59 MDW Gifts and Grants Office to 502 ISG/JAC.

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NOTE: All abstracts, papers, posters, etc., should contain the following disclaimer statement:

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"The experiments reported herein were conducted according to the principles set forth in the National Institute of Health Publication No. 80-23, Guide for the Care and Use of Laboratory Animals and the Animal Welfare Act of 1966, as amended."

PROCESSING OF PROFESSIONAL MEDICAL RESEARCH/TECHNICAL PUBLICATIONS/PRESENTATIONS			
1. TO: CLINICAL RESEARCH	2. FROM: (Author's Name, Rank, Grade, Office Symbol) Brian P. Murray, Capt, USAF, MC 44E1A	3. GME/GHSE STUDENT: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	4. PROTOCOL NUMBER:
5. PROTOCOL TITLE: (NOTE: For each new release of medical research or technical information as a publication/presentation, a new 59 MDW Form 3039 must be submitted for review and approval.) N/A			
6. TITLE OF MATERIAL TO BE PUBLISHED OR PRESENTED: Hydrofluoric Acid - The Burn that Keeps on Burning			
7. FUNDING RECEIVED FOR THIS STUDY? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO FUNDING SOURCE:			
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14. 59 MDW PRIMARY POINT OF CONTACT (Last Name, First Name, M.I., email) Murray, Brian P. brian.p.murray20.mil@mail.mil			15. DUTY PHONE/PAGER NUMBER 201-562-4686
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a. Primary/Corresponding Author Brian P. Murray, DO	Capt	959CSPS/59MDW/44E1A	
b. Daniel J. Sessions	MAJ		USARMY - BAMC
c.			
d.			
e.			
17. IS A 502 ISG/JAC ETHICS REVIEW REQUIRED (JER DOD 5500.07-R)? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			
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Hydrofluoric Acid – The Burn that Keeps on Burning

Brian P. Murray DO, Capt, USAF, MC; Daniel J. Sessions, MD, MAJ, USA, MC
San Antonio Military Medical Center, Fort Sam Houston, TX



HPI

CC: "right hand pain"

HPI: A 40-year-old man presented to the Emergency Department with the complaint of pain to his right hand. Three-hours prior he had been using rust remover to clean the air-conditioning unit in his house. Now the patient has exquisite pain to his distal thumb, index finger and middle fingers.

PMHx: Denies.

Physical Exam

HR 66 bpm, RR 15 rpm, BP 143/95mmHg, SpO₂ 96% RA
General: mild painful distress, Alert
Cardiac: RRR, no R/G/M
Pulmonary: CTA B/L, No W/R/R.
Skin: Blanched, bluish hue, fingers tips, severely tender to palpation, otherwise no rashes, ulcers, discolorations.

Labs / EKG

Sodium 139, Potassium 3.9, Glucose 107, Calcium 8.8, Magnesium 2.0

CBC: NML; RFP: NML

EKG: NSR at 83 BPM, PR 158 ms, QRS 104 ms, QT 378 ms, normal ST segment and T waves.

Questions

1. What is the mechanism by which the chemical that burned this patient exerts its toxic effect?
2. What are the three treatments used for this type of exposure?

REFERENCES

1. Vance MV, Curry SC, Kunkel DB, Ryan PJ, Ruggeri SB. Digital hydrofluoric acid burns: treatment with intraarterial calcium infusion. YMEM. 1986 Aug;15(8):890-6.
2. Anderson WJ, Anderson JR. Hydrofluoric acid burns of the hand: mechanism of injury and treatment. The Journal of hand surgery. 1988;13(1):52-7.
3. Sheridan RL, Ryan CM, Quinby WC, Blair J, Tompkins RG, Burke JF. Emergency management of major hydrofluoric acid exposures. Burns. 1995 Feb;21(1):62-4.
4. Kirkpatrick JJ, Enion DS, Burd DA. Hydrofluoric acid burns: a review. Burns. 1995 Nov;21(7):483-93.
5. Hatzifotis M, Williams A, Muller M, Pegg S. Hydrofluoric acid burns. Burns. 2004 Mar;30(2):156-9.

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Images

Two images of the affected fingers showing A) the bluish hue of the blanched right index finger with incisions used to relieve the pressure of local infusion of 10% calcium gluconate into the tips of the fingers and B) the arterial catheter placed for arterial infusion of 10% calcium gluconate.

Case Conclusion

The chemical was compound 90-920, which contains 10% HF solution. Topical calcium and local infusion of calcium were not sufficient to control his pain and an intra-arterial catheter was placed and infusion of 10% calcium gluconate was started. The patient was admitted to the burn ICU where he eventually required excision of the tips of his fingers due to tissue necrosis.

Pearls

1. The F⁻ ion causes significant tissue damage and pain through formation of insoluble salts and calcium depletion.
2. Even small burns with concentrated HF can lead to significant systemic toxicity and death.
3. Treatment with 2.5% topical calcium gluconate, 0.5 ml/cm² of 10% calcium gluconate, and 10ml of 10% calcium gluconate or chloride in 40-50 ml 5% dextrose over 4 hours may be needed to neutralize the F⁻ ions.

Answers

1. Hydrofluoric Acid (HF) burns causes tissue damage through two mechanisms.
 - i. Rapid release of hydrogen ions and subsequent tissue dehydration and coagulation necrosis. HF is a weak acid and the chemical burn generated by the free hydrogen ions is relatively insignificant.
 - ii. Release of the highly reactive free fluoride ion, F⁻, after the uncharged HF molecule penetrates deeply into the underlying tissue. The F⁻ causes liquefaction necrosis and forms insoluble salts CaF₂ and MgF₂. Potassium ions are released from the peripheral nerve endings in response to Ca²⁺ depletion causing severe pain. Hypocalcemia and hypomagnesemia can occur in larger burns or burns with concentrated HF and death has been documented from burns as small as 2.5% total body surface area burn from highly concentrated HF exposure.
2. There are three levels of treatment for HF burns.
 - i. Topically apply a 2.5% calcium gluconate slurry, made by mixing 3.5 gm of calcium gluconate in 5 oz of a water based lubricant. This treatment has excellent efficacy at preventing further tissue damage and decreasing pain, especially if used soon after the exposure. Putting a glove over the exposed hand when using the calcium slurry can help keep the gel in place and prevent evaporation and rubbing off of the calcium.
 - ii. If this is not effective at treating patient's pain after 30 minutes and the area of tissue damages increases, local infiltration with 10% calcium gluconate at a dose of 0.5 ml per cm² body area is used. This method is more effective at treating deeper exposures. Calcium gluconate is used instead of calcium chloride since despite having three times more calcium, the calcium chloride itself is irritating and toxic to local tissue. If infiltration is going to be performed in the pads of the fingers, a prophylactic fasciotomy is recommended to prevent compartment syndrome from the injection of a large amount of fluid into a small compartment.
 - iii. If the pain is still not controlled, intra-arterial infusion of 10 ml of 10% calcium gluconate or calcium chloride (in 40-50 ml 5% dextrose) over 4 hours will allow large amounts of calcium to be delivered directly to the damaged tissue and this infusion can be repeated until the patient is pain free.